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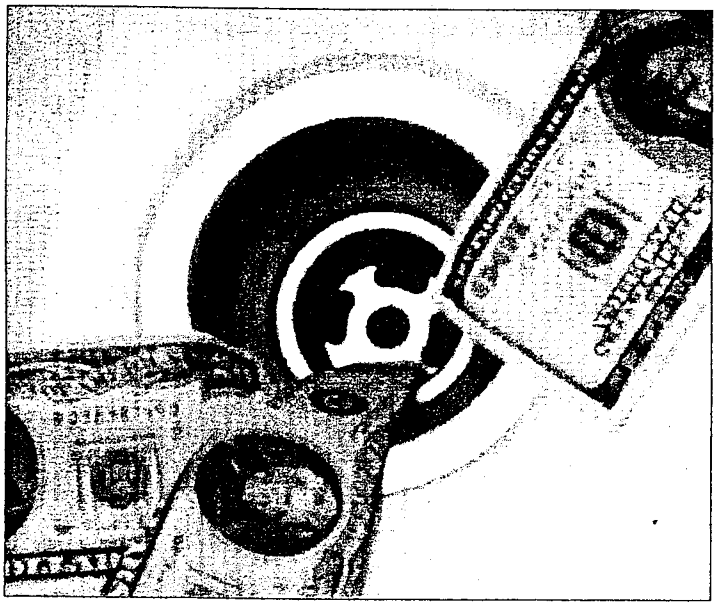
Nitrate Alarmists Cost Consumers Plenty

by Alex Avery



Early in the Bush administration, a political row erupted over proposed changes in the maximum contaminant level (MCL) for arsenic in drinking water. In its final weeks, the Clinton administration initiated a 10-fold reduction in the MCL for arsenic, from 50 parts per million (ppm) to 5 ppm. The Bush administration suspended the change pending a reexamination of the science by the National Research Council.

The new MCL would be particularly burdensome on poor, rural communities, Bush administration officials explained. While the health risks of maintaining the MCL at 50 ppm appeared to be small, the compliance costs for reducing it were very high.

A similar small risk/high cost drinking water regulation has received almost no attention: the limit on nitrate in drinking water, currently set at 10 ppm. That regulation is costing U.S. communities and homeowners hundreds of millions of dollars per year, and the cost is increasing.

The Environmental Protection Agency is increasing its pressure on state agencies to enforce the standard, even though there is no evidence of a problem. Moreover, as communities grow, more are reaching the threshold at which the regulation is enforced. (The regulation applies to community water systems serving more than 15 homes or 25 people.)

Basis for Current Standard

Nitrate levels in drinking water are regulated for one reason only: to prevent blue baby syndrome, medically known as infantile methemoglobinemia. Blue baby syndrome affects infants less than one year old, most often those younger than 6 months. The syndrome occurs when nitr*ites* bind to hemoglobin (the oxygen carrier in red blood cells), knocking off oxygen, and thereby preventing oxygen transport. The condition literally turns babies blue, the color of deoxygenated blood.

The federal MCL for nitrates was established in 1963 and is based on data from a mere five blue baby cases identified in a survey conducted in 1949 by the American Public Health Association (APHA). During the 1940s, a number of blue baby cases connected to water contaminated with high nitrate levels was reported in medical journals. It was known that nitr*ites* were toxic and caused methemoglobinemia in humans of all ages. On the theory that gut bacteria can convert nitr*ate* (NO3) into toxic nitr*ite* (NO2), the APHA concluded the evidence warranted limiting infant exposure to nitrates. (At the time, many infants were fed powdered infant formula reconstituted with well or tap water, exposing them to nitrates in drinking water.)

In an effort to determine a safe level of nitrates, the APHA surveyed state health departments asking for information on blue baby cases "definitely associated with nitrate-contaminated water." All but one state responded to the survey. Seventeen states submitted data on a total of 214 blue baby cases. Most cases occurred at nitrate levels greater than 40 ppm, while five were reported at levels between 11 and 20 ppm. Since no blue baby cases were reported at nitrate levels below 10 ppm, this became the federal MCL.

No one knows if the information gathered by the APHA in 1949 is accurate. Many of the survey's blue baby cases were never formally diagnosed. Moreover, the survey is badly flawed because nitrate concentration data were often collected months after the blue baby event; nitrate levels in drinking water can vary dramatically over relatively short periods of time.

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Finally, APHA never considered the fact that blue baby syndrome can be caused by internal (endogenous) factors, without any exposure to external nitrates or nitrites. APHA simply assumed that in blue baby cases where nitrates were present, the nitrates were the cause.

The most common cause of endogenous blue baby syndrome appears to be gastrointestinal maladies, such as gastroenteritis and diarrhea. Symptoms of gastrointestinal disorders, such as diarrhea and vomiting, are present in a majority of blue baby cases linked to nitrate-contaminated water.

Moreover, doctors in the 1940s were unable to cause blue baby syndrome in hospitalized infants by exposing them to formula with 100 ppm nitrate alone. Blue baby syndrome occurred only when the infants were exposed to 100 ppm nitrate nitrogen *and* pathogenic bacteria. Even then, the effects weren't dramatic. Thus, the relatively low nitrate levels in the five blue baby cases from the APHA survey were likely unrelated to the blue baby occurrences.

The MCL and Prevention Approach

Today, blue baby syndrome is an extremely rare event in developed countries. Most rural doctors in the United States have never seen even a single case, let alone a death. It is unclear whether this is due to increased awareness in areas where nitrates are present, a reduction in the use of powdered/concentrated infant formula that requires reconstitution with water, or a reduction in the endogenous factors that cause blue baby syndrome (i.e. gastrointestinal infections, diarrhea, etc.).

EPA estimated in 1990 that 66,000 infants are exposed annually to drinking water whose nitrate levels exceed the MCL, so we obviously haven't removed infant exposures to water with moderate nitrate levels.

While the supposed health threat from nitrates is limited to young infants, the MCL is imposed on all water from public water systems. This is a colossal waste of money, as 99.99 percent of the water is used for purposes other than diluting concentrated infant formula. It would be far cheaper simply to ban the sale of concentrated infant formulas, or even to provide 6 months of fully constituted infant formula to all mothers in affected areas.

Raising the MCL to 20 ppm nitrate-nitrogen would not be without precedent. Oklahoma, for example, maintained an MCL of 20 ppm until 1994, when EPA pressured the state to adopt the federal standard. Despite the higher MCL, Oklahoma had only one blue baby case reported in public health records over the past 40 years.

With the adoption of the lower federal MCL, some 20 rural Oklahoma communities suddenly face huge costs to solve a health problem none has ever experienced. For example, the small town of Hennessey, Oklahoma (population 2,058) is facing nearly $2 million in water treatment equipment costs, sizeable annual maintenance expenditures, and at least a doubling of the town's annual water use. All of the additional water used will be waste water from continually flushing the membrane filtration system in an area already short of water. The purpose of all this expense and waste? Reducing the nitrate levels in the town's water from 12 ppm to 9.9 ppm nitrate-nitrogen. This is just one tiny town in one state.

Nor does this regulation affect only municipal water suppliers. Any water system that serves more than 15 homes or 25 persons must comply. Individual homeowners are affected as well, because many homebuyers won't purchase a home with well water that does not meet a federal health standard. Homeowners whose groundwater exceeds the federal MCL find themselves either digging new wells, paying $1,000+ per tap to install point-of-use water treatment systems, or investing several thousand dollars in a whole-house filtration system.

When all of these costs are added up, the burden on U.S. communities likely exceeds $150 million per year and perhaps far more. Unfortunately, not even EPA has a credible estimate. In virtually all currently affected areas, the nitrate levels are less than 20 ppm, meaning a revision of the MCL would virtually eliminate these costs.

EPA's current MCL for nitrates in water has a shaky scientific basis and a dubious public health benefit, while costing huge sums for those communities affected. Congress has a duty to demand a thorough scientific review of

SENATE NATURAL RESOURCES
EXHIBIT NO. 1
DATE 3/9/11
BILL NO HB 352

Sources of Contamination

"All sources of drinking water are subject to potential contamination by constituents that are naturally occurring or is man made. Those constituents can be microbes, organic or inorganic chemicals, or radioactive materials." All drinking water may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants ~~does not necessarily~~ indicate that the water poses ~~a health risk.~~ More information about ~~contaminants~~ and potential health effects can be obtained by calling the Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791.

MCLs (Maximum Contaminant Levels) are set at very stringent levels. To understand the possible health effects described for many regulated constituents, a person would have to drink 2 liters of water a day at the MCL level for a lifetime to have a one-in-a-million chance of having the described health effect.

Calculating Reference Dose

- RfD(mg/kg/day) = NOAEL(mg/kg/day) / Safety Factor
- Safety factor of 100 usually used
  - factor of 10 for human/animal response differences
  - factor of 10 for inter-individual response differences
  - additional safety factor of 10 applied if data are questionable

Adults can tolerate higher levels of nitrate-nitrogen with little or no documented adverse health effects and may be able to drink water with nitrate-nitrogen concentrations considerably greater than the 10 mg/L level with no acute toxicity effects. However, little is known about possible long-term chronic effects of drinking high nitrate water. If your water test indicates a level of nitrate-nitrogen above 10 mg/L and only adults or older children will be drinking it, consult your family physician for a medical recommendation.

I Know Some

A potential cancer risk from nitrate (and nitrite) in water and food has been reported. A possibility exists that nitrate can react with amines or amides in the body to form nitrosamine which is known to cause cancer. Nitrate must be converted to nitrite before nitrosamine can be formed. The magnitude of the cancer risk from nitrate in drinking water is not known.

The primary health hazard from drinking water with nitrate-nitrogen occurs when nitrate is transformed to nitrite in the digestive system. The nitrite oxidizes iron in the hemoglobin of the red blood cells to form methemoglobin, which lacks the oxygen-carrying ability of hemoglobin. This creates the condition known as methemoglobinemia (sometimes referred to as "blue baby syndrome"), in which blood lacks the ability to carry sufficient oxygen to the individual body cells causing the veins and skin to appear blue.

Most humans over one year of age have the ability to rapidly convert methemoglobin back to oxyhemoglobin; hence, the total amount of methemoglobin within red blood cells remains low in spite of relatively high levels of nitrate/nitrite uptake. However in infants under six months of age, the enzyme systems for reducing methemoglobin to oxyhemoglobin are incompletely developed and methemoglobinemia can occur. This also may happen in older individuals who have genetically impaired enzyme systems for metabolizing methemoglobin.

In 1962, the U.S. Public Health Service adopted drinking water standards and set the recommended limit for nitrate-nitrogen at 10 mg/L. This drinking water standard was established to protect the health of infants and was based on the best knowledge available. The potential health hazard for others depends on the individual's reaction to nitrate-nitrogen and the total ingestion of nitrate-nitrogen and nitrites from all sources.

The Environmental Protection Agency (EPA) has since adopted the **10 mg/L standard as the maximum contaminant level (MCL) for nitrate-nitrogen** and **1 mg/L for nitrite-nitrogen for regulated public water systems**. Subsequent reviews of this standard have not resulted in any changes. However, it is difficult to establish an exact level at which nitrogen concentrations in water are safe or unsafe. The intake of nitrogen from food and other sources also is important and must be considered.

Even though the MCL for nitrate-nitrogen in drinking water is 10 mg/L, there have been cases where infants have been exposed to water with nitrate-nitrogen concentrations greater than 10 mg/L without developing methemoglobinemia. Definitive guidelines for determining susceptibility to methemoglobinemia have not been developed. Therefore, if your water contains more than 10 mg/L nitrate-nitrogen, it is advisable to use an alternate source of water for infant formula and food.

Are there special considerations for small systems?

Small systems receive special consideration from EPA and states. More than 90 percent of all PWS are small, and these systems face the greatest challenge in providing safe water at affordable rates. The 1996 SDWA Amendments provide states with tools to comply with standards affordable for small systems. When setting new primary standards, EPA must identify technologies that achieve compliance and are affordable for systems serving fewer than 10,000 people. These may include packaged or modular systems and point-of-entry/point-of-use treatment devices under the control of the water system. When such technologies cannot be identified, EPA must identify affordable technologies that maximize contaminant reduction and protect public health. Small systems are considered in three categories: serving 10,000-3301 people; 3,300-501 people; and 500-25 people.

After determining a MCL or TT based on affordable technology for large systems, EPA must complete an economic analysis to determine whether the benefits of that standard justify the costs. If not, EPA may adjust the MCL for a particular class or group of systems to a level that "maximizes health risk reduction benefits at a cost that is justified by the benefits." EPA may not adjust the MCL if the benefits justify the costs to large systems, and small systems unlikely to receive variances.

States are authorized to grant **variances** from standards for systems serving up to 3,300 people if the system cannot afford to comply with a rule (through treatment, an alternative source of water, or other restructuring) and the system installs EPA-approved variance technology. States can grant variances to systems serving 3,301-10,000 people with EPA approval. SDWA does not allow small systems to have variances for microbial contaminants.

The MCL is set as close to the MCLG as feasible, which the Safe Drinking Water Act defines as the level that may be achieved with the use of the best available technology, treatment techniques, and other means which EPA finds are available(after examination for efficiency under field conditions and not solely under laboratory conditions) are available, taking cost into consideration.